

## Single-variable porous nanomaterial series from polymer structure-directing agents

Morgan Stefik

Open Access

Block polymer structure-directing agents (SDAs) enable the production of porous nanoscale materials. Solution-type SDAs include dynamic and persistent micelles. Persistent micelle templates (PMTs) use high solvent selectivity for kinetic entrapment. PMTs enable independent wall thickness control down to 2 Å precision. The authors demonstrate unimodal PMTs with pore sizes from 11.8 to 109 nm and multimodal pore sizes up to 290 nm and discuss application of PMT-tailored nanomaterials. <https://doi.org/10.1557/s43578-021-00421-0>

## Collagen-derived peptide, DGEA, inhibits pro-inflammatory macrophages in biofunctional hydrogels

Aakanksha Jha, Erika Moore

Open Access

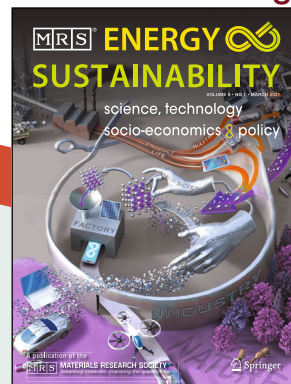
Long-term exposure to inflammatory stimuli causes an increase in M1 macrophages, which contributes to chronic inflammation. A biofunctional hydrogel utilizing a collagen I-derived peptide, DGEA (Asp-Gly-Glu-Ala) and poly(ethylene glycol) (PEG) was designed to reduce macrophage activation. M1 macrophage activation was reduced via soluble delivery of DGEA in 2D, and via immobilized DGEA in a 3D PEG-DGEA hydrogel. <https://doi.org/10.1557/s43578-021-00423-y>

## Operando bulk and interfacial characterization for electrochemical energy storage: Case study employing isothermal microcalorimetry and x-ray absorption spectroscopy

Wenzao Li, Mallory N. Vila, Lisa M. Housel, Nahian Sadique, Genesis D. Renderos, Steve Ehrlich, David C. Bock, Lei Wang, Kenneth J. Takeuchi, Esther S. Takeuchi, Amy C. Marschilok

Open Access

Battery innovation originates by understanding charge transport phenomena at multiple time and length scales. The authors highlight progress in bulk and interfacial *operando* characterization of batteries by combining x-ray absorption spectroscopy and isothermal microcalorimetry. Case studies involving Fe<sub>3</sub>O<sub>4</sub> demonstrate real-time characterization of productive faradaic redox processes and parasitic interfacial reactions during (de)lithiation during battery function. <https://doi.org/10.1557/s43578-021-00350-y>



## Active learning as enabler of sustainability learning outcomes: Capturing the perceptions of learners during a materials education workshop

Vasiliki Kioupi, Tatiana V. Vakhitova, Katherine A. Whalen

Open Access

Active learning is a promising teaching approach that can develop sustainability competencies in learners. The authors investigate the potential of active-learning pedagogies such as serious games and active-learning toolkits to deliver sustainability knowledge and skills in materials education. They provide recommendations for educators on how to implement active learning in materials education in order to empower students with skills for sustainability. <https://doi.org/10.1557/s43581-021-00019-3>

## Driving Zn–MnO<sub>2</sub> grid-scale batteries: A roadmap to cost-effective energy storage

Erik D. Spoerke, Howard Passell, Gabriel Cowles, Timothy N. Lambert, Gautam G. Yadav, Jinchao Huang, Sanjoy Banerjee, Babu Chalamala

Open Access

Few technologies can offer the potential of large-scale manufacturing of batteries that can provide storage at costs as low as \$50/kWh. Zn–MnO<sub>2</sub> batteries have the potential to realize this goal in a safe, environmentally friendly, and reliable package that could revolutionize large-scale energy storage at a time when it is needed most. By examining manufacturing examples at the Zn–MnO<sub>2</sub> battery manufacturer Urban Electric Power, the authors show a roadmap to realize such low-cost systems. <https://doi.org/10.1557/s43581-021-00018-4>

## Opportunities and challenges for integrating the development of sustainable polymer materials within an international circular (bio)economy concept

Natalia A. Tarazona, Rainhard Machatschek, Jennifer Balcucho, Jinneth Lorena Castro-Mayorga, Juan F. Saldarriaga, Andreas Lendlein

Open Access

Leading-edge polymer-based materials for consumer and advanced applications are necessary to achieve sustainable development at a global scale. It is essential to understand how sustainability can be incorporated via green chemistry, circular bioeconomy strategies, and combined smart and functional capabilities. The authors focus on tools to measure and reduce the negative impacts of plastics throughout their life cycle, the use of renewable sources, the design of biodegradable and/or recyclable materials, and biotechnological strategies for enzymatic recycling that fit into a circular bioeconomy. <https://doi.org/10.1557/s43581-021-00015-7>



## Improving electric thermal stability of polypropylene by chemically linking small amount of hindered phenol groups

Xin Chen, Wenyi Zhu, Q.M. Zhang

Polypropylene's (PP) electrical properties help make an appealing electret and a leading material for creating electrostatically charged filters in the now common face mask applications. The authors show that by adding less than 1% of phenol groups to PP, the resulting co-polymer is both mechanically and electrically more stable than the virgin polymer, creating a route for continued optimization of electrostatic charge capacity. <https://doi.org/10.1557/s43580-021-00016-1>

## PDMS composites with photostable NIR dyes for multi-modal ultrasound imaging

India Lewis-Thompson, Shaoyan Zhang, Sacha Noimark, Adrien E. Desjardins, Richard J. Colchester

Open Access

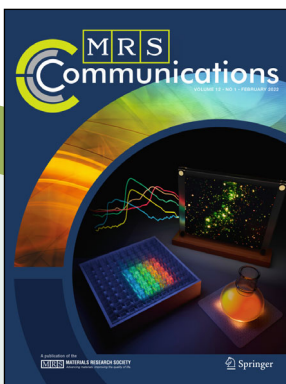
Creating materials that could be utilized for both ablation and medical imaging using optical ultrasound requires control of the optical absorption. The authors use a commercial dye in poly(dimethylsiloxane) (PDMS) and demonstrate that peak ultrasound pressure performance occurs at moderate compositions, as absorption increases with increasing dye loading, but high loading decreases overall pressure, likely due to attenuation. All the PDMS dyed with this compound were photostable for more than an hour of use. <https://doi.org/10.1557/s43580-022-00208-3>

## Long-term stability of uranium-oxide-based microparticle reference materials: Shelf-life in alcoholic suspension and storage media

Shannon Kimberly Potts, Philip Kegler, Simon Hammerich, Martina Klinkenberg, Irmgard Niemeyer, Dirk Bosbach, Stefan Neumeier

Open Access

Creating standard reference materials for swipe tests used by the International Atomic Energy Agency safeguard inspectors requires stable and predictable suspensions. The authors report the first data from a stability study of how uranium oxide microparticles are altered by long-term storage in a variety of alcohols over periods from days to up to four years of storage, and provide suggestions for candidate standard suspensions. <https://doi.org/10.1557/s43580-022-00216-3>



## Rapid testing for Coronavirus disease 2019 (COVID-19)

Alexander Biby, Xiaochuan Wang, Xinliang Liu, Olivia Roberson, Allya Henry, Xiaohu Xia

Methods of detection and testing of the SARS-CoV-2 virus, better known as COVID-19, is a timely topic as the search for rapid testing methods has accelerated. A paper-based diagnostic platform, or LFA, is a cost-effective method with high detection selectivity and sensitivity, which is ideal. The authors summarize the pros, cons, and challenges of LFA-based assays for future technologies. <https://doi.org/10.1557/s43579-021-00146-5>

## Synergistic effects of a novel multi-branched polylactide ionomer on polylactide film

Sorapat Niyomsin, Thanphisit Thongsima, Suttinun Phongtamrug, Suwabun Chirachanchai

Macromolecular design and precision synthesis in polylactides can be prepared as multi-branched topologies and ionomer functionality from polyethylene imine cores. The applications of the films include gas permeability control and modification with the ionomers as additives for oxygen membrane design. The authors emphasize structure–composition–property relationship. <https://doi.org/10.1557/s43579-022-00155-y>

## Higher conductivity of non-stoichiometric lithium lanthanum zirconate ceramics made by reactive flash synthesis

Thomas Clemenceau, Rishi Raj

There is high interest in alumina-doped lithium lanthanum zirconate as high-performance ceramic materials. The use of reactive flash synthesis enables the processing of complex ceramics with low temperatures and shorter processing times. The concept of non-stoichiometry and high entropy compositions is a possibility for enhancing lithium-ion conductivity. <https://doi.org/10.1557/s43579-022-00162-z>